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## C-A OPERATIONS PROCEDURES MANUAL

### 7.1.25 Liquid Storage Cooldown and Fill Procedure

Text Pages 2 through 11

#### Hand Processed Changes

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Approved: \_\_\_\_\_ *Signature on File* \_\_\_\_\_  
Collider-Accelerator Department Chairman Date

S. Sakry

## 7.1.25 Liquid Storage Cooldown and Fill Procedure

### 1. Purpose

This procedure provides instructions for cooling down and filling the liquid storage dewars in three phases. Phase 1 establishes flow in the vacuum jacketed refrigerator-ring (VJRR) line. Phase 2 uses the heat shield line and the supply line from the refrigerator to cool down the liquid dewars. Phase 3 fills the dewars from a bulk helium tanker.

### 2. Responsibilities

- 2.1 The shift supervisor or an operator designated by the shift supervisor is responsible for conducting the procedure and providing documentation in the cryogenic control room log and in the cryogenic valve log.
- 2.2 Should a problem arise in the process of cooling down or filling the liquid storage area, the shift supervisor shall report to the technical supervisor for instructions before continuing.

### 3. Prerequisites

- 3.1 The operator shall be trained by the shift supervisor.
- 3.2 Operator shall be familiar with the following drawings:

Drawing 3A995009	25 KW Helium Refrigerator P & ID
Drawing 3A995064	4:00 Yellow Ring P & ID
Drawing 3A995066	6:00 Yellow Ring P & ID
Drawing 3A995084	4:00 Yellow Ring P & ID
Drawing 3A995086	6:00 Yellow Ring P & ID
Drawing 3A995073	RHIC Helium Storage P & ID
Drawing 3A995108	RHIC Magnet Scrub and Warm Up System Block Diagram
- 3.3 Operator shall be familiar with the physical location of components on the drawings listed under 3.2.
- 3.4 Operator shall be familiar with the control pages found on the CRISP control system.

3.5 At the 6:00 Yellow valve box, the following valves shall be CLOSED:

H6605A	H6620A	H6716A
H6611A	H6701A	
H6616A	H6702A	

3.6 At the 6:00 Yellow valve box, the following valves shall be OPEN:

H6602A	H6745A
H6610A	

3.7 At the 4:00 Yellow valve box, the following valves shall be CLOSED:

H6401A	H6411A	H6422M
H6402A	H6416A	H6430A

3.8 At the 4:00 Yellow valve box, the following valves shall be OPEN:

H6410A	H6426M
H6415A	

3.9 At the liquid storage area, the following valves shall be CLOSED:

H4505A	H9724M	H9752A
H4526A	H9725M	H9754M
H9703A	H9726A	H9775M
H9706A	H9727M	H9782A
H9707A	H9733A	H9784M
H9708M	H9734A	H9785M
H9709A	H9742A	H9786M
H9710M	H9743M	H9788M
H9713A	H9744M	H9793M
H9714A	H9749M	H9795M
H9718M	H9750A	
H9723A	H9751A	

3.10 At the liquid storage, the following valves shall be OPEN:

H4525A	H9719M	H9741M
H9700M	H9722M	H9746M
H9701M	H9728M	H9755M
H9702M	H9729M	H9756M
H9704A	H9731A	H9776M
H9705A	H9732M	H9777M
H9711A	H9735M	H9789M
H9712M	H9736M	H9791M
H9715M	H9739M	H9794M
H9716M	H9740M	

3.11 At the refrigerator, the following valves shall be CLOSED:

H26A	H238M	H776M
H33M	H346M	H799M
H146A	H376M	H809M
H147A	H399M	H825M
H157M	H409M	H4644A
H158M	H413M	H4658A
H171M	H425M	H4659M
H187M	H746M	

3.12 At the refrigerator, the following valves shall be OPEN:

H5M	H156M	H849A
H9A	H827M	H4643M

3.13 The cool down return line must be available for use at the refrigerator. If it is not available, re-evaluate the situation before executing this procedure. (It is still possible to perform this procedure depending on what portion of the cool down return line is in use.)

3.14 Verify that flex lines that will be used in the transfer of helium from the bulk helium tanker have been cleaned and dried.

3.15 In order to cool down the three liquid dewars at the liquid storage area, the RHIC gas storage tanks must have a minimum inventory of 750,000 SCF of helium available.

#### **4. Precautions**

- 4.1 All personnel involved in the transfer of liquid from the bulk helium tanker to the RHIC liquid storage dewars shall wear appropriate safety attire for the handling of cryogenic liquids.
- 4.2 This procedure provides step-by-step instructions for cooling down and filling liquid storage dewar #1. If cooling down liquid storage dewar # 2 or #3, adjust valve selection appropriately.
- 4.3 This procedure uses the 6:00 and 4:00 yellow valve boxes to cool the VJRR line and the supply line. If the 6:00 and 4:00 blue valve boxes are used, adjust valve selection appropriately. The yellow and blue valve boxes are mirror images.

#### **5. Procedure**

- \_\_\_\_\_ 1. Verify valve positions as specified in prerequisites 3.5 through 3.12.
- Phase 1: Establish VJRR shield flow
- \_\_\_\_\_ 2. Establish flow through the VJRR with the valve configuration specified in the prerequisites by opening H25A.
  - \_\_\_\_\_ 3. Monitor the temperature of the cooldown return flow at temperature sensor TI8H. When TI8H reaches 200°K, open valve H425M slowly.
  - \_\_\_\_\_ 4. Close valve H827M.
  - \_\_\_\_\_ 5. Monitor the temperature of the cooldown return flow at TI8H (temperature indicator 8H). When TI8H reads ~ 120°K open valve H376M.
  - \_\_\_\_\_ 6. Close valves H425M and H156M. Set valve H9A for a flow of 200g/sec.
  - \_\_\_\_\_ 7. Monitor the temperature of the cooldown return flow at TI8H (temperature indicator 8H). When TI8H reads ~80°K, go to Phase 2.

Phase 2: Pre-cool helium dewar(s) with heat shield supply and 4°K supply

\_\_\_\_\_ 8. At the refrigerator, open valve H849A.

\_\_\_\_\_ 9. At the refrigerator, close valve H5M.

\_\_\_\_\_ 10. At the liquid storage area, open or verify open the following valves  
(See note 4.2):

H4525A

H4526A

H9704A

H9731A

\_\_\_\_\_ 11. At the 6:00 yellow valve box, open the following valves:

H6601A

H6609M

H6615A

H6616A

12. Flow through the dewar will be controlled by opening and adjusting valve H9734A. Adjust H9734A to pressurize and maintain the dewar at 1.5 atmospheres.

**Caution 1:**

Do not exceed 1.7 atmospheres in the liquid dewar

**Caution 2:**

From this point on, the operator needs to be constantly aware of the condition of the refrigerator. The refrigerator needs to remain at normal operating temperatures throughout the system so as not to move contamination around in the refrigerator. The operator shall pay particular attention to temperature sensor TI3063 on the low pressure return to the compressors. Should TI3063 drop below 270°K, open valves H1103A and H1104M at the refrigerator and close valve H4643A to send flow through the thermax heaters.

\_\_\_\_\_ 13. Monitor the return temperature from dewar #1 by monitoring temperature sensor TT105H. When TT105H reaches 200°K, open valve H4644A.

**Caution 3:**

The following bypass changes assume that the "A" string warm turbines are in use. If "B" string turbines are in use, adjust valve selection accordingly.

- \_\_\_\_\_ 14. Open valve H425M slowly to introduce helium into the return side of heat exchanger 3A.
- \_\_\_\_\_ 15. Close valve H849A
- \_\_\_\_\_ 16. Continue to monitor the return temperature from dewar #1 by monitoring temperature sensor TT105H. When TT105H reads ~ 80°K, verify that valve H26A is closed.
- \_\_\_\_\_ 17. At the 6:00 yellow valve box, close the following valves:  
  
H6616A  
H6615A
- \_\_\_\_\_ 18. Continue to monitor the return temperature from dewar #1 by monitoring temperature sensor TT105H. When TT105H reads less than 80°K, slowly start to open valve H146A at the refrigerator.

**Warning:**

As the liquid dewar starts to cool and fill with liquid, the heat load on the refrigerator will change. Continuously monitor the refrigerator and adjust the calorimeter to maintain a balanced heat load.

- \_\_\_\_\_ 19. Re-adjust valve H9734A to maintain 1.5 atmospheres in the dewar.
- \_\_\_\_\_ 20. Continue to monitor the return temperature from dewar #1 by monitoring temperature sensor TT105H. When TT105H reads less than 50°K, open valve H157M.
- \_\_\_\_\_ 21. Close valve H425M.

**Caution 4:**

The following bypass changes assume that the “A” string cold turbines are in use. If “B” string turbines are in use, adjust valve selection accordingly.

- \_\_\_\_\_ 22. Continue to monitor the return temperature from dewar #1 by monitoring temperature sensor TT105H. When TT105H reads 7°K, open valves H26A and H409M.
- \_\_\_\_\_ 23. Close valve H157M.
- \_\_\_\_\_ 24. Continue to monitor the return temperature from dewar #1 by monitoring temperature sensor TT105H. When TT105H reads 5°K, open valve H33M.
- \_\_\_\_\_ 25. Close valve H409M.
- \_\_\_\_\_ 26. Look for the rate of change in the dewar weight to increase and look for liquid to start to accumulate in the dewar.

**Caution 5:**

Periodically check the gas inventory available to insure that the cooldown can be completed (see section 3.15 if in doubt).

- \_\_\_\_\_ 27. Continue to cool the dewar until the dewar weight shows 125 kg.
- \_\_\_\_\_ 28. Throttle H9734A back to maintain minimal flow to the dewar thus preventing increased gas consumption.
- \_\_\_\_\_ 29. Adjust calorimeter to compensate for lack of heat load at the liquid dewar and to maintain balance in the cold end of the refrigerator.
- \_\_\_\_\_ 30. The liquid dewar is now ready for a bulk helium delivery. If a bulk helium tanker is available to fill the dewar, go to Phase 3.

Phase 3: Dewar(s) fill

- \_\_\_\_\_ 31. Clean and dry flex line that is to be used in the transfer of helium from the bulk helium tanker to the liquid storage dewar.

- \_\_\_\_\_ 32. Hook up the fill line from the bulk helium tanker to the liquid dewar's bulk fill line.
- \_\_\_\_\_ 33. From the gas storage tanks, purge and connect the line to pressurize the helium bulk tanker.
- \_\_\_\_\_ 34. Purge the fill line by opening valve H9785M on dewar #3 and by opening the appropriate purge supply valve on the bulk helium tanker.
- \_\_\_\_\_ 35. After the line has been purged, close valve H9785M.
- \_\_\_\_\_ 36. Purge and connect the vent lines at the helium bulk tanker.
- \_\_\_\_\_ 37. Maintain a 3-5 PSI pressure differential between the liquid storage dewar and the bulk helium tanker by adjusting the regulator that controls the gas pressure going into the helium bulk tanker.
- \_\_\_\_\_ 38. Note and record the liquid level in the helium bulk tanker.
- \_\_\_\_\_ 39. To pre-cool the bulk fill line, open valve H9785M on dewar #3.
- \_\_\_\_\_ 40. Open the supply valve on the bulk helium tanker and pre-cool the bulk fill line until liquid air is visible on the line. Close valve H9785M.
- \_\_\_\_\_ 41. Verify that valves H4525A, H9704A, H9731A, and H9732M are open to provide a return path back to the refrigerator.
- \_\_\_\_\_ 42. Open valve H9744M on dewar #1 and start filling the dewar.
- \_\_\_\_\_ 43. Maintain a 3-5 PSI pressure differential between the liquid storage dewar and the bulk helium tanker by adjusting the regulator that controls the gas pressure going into the helium bulk tanker.
- \_\_\_\_\_ 44. Continue filling the liquid storage dewar until the bulk helium tanker is empty. One sign that the bulk helium tanker is empty will be when the pressure between the bulk helium tanker and the liquid storage dewar equalizes and a differential pressure can no longer be maintained.
- \_\_\_\_\_ 45. When the helium bulk tanker is empty, close the supply at the helium bulk tanker and close valve H9744M on dewar #1.

- \_\_\_\_\_ 46. Stop pressurizing the helium bulk tanker with gas from gas storage.
- \_\_\_\_\_ 47. Through the vent line, reduce the pressure in the bulk helium tanker below 3 PSI by opening either valve H3244M or H3245M depending on where the vent line is attached, and by opening the vent valve on the bulk helium tanker.
- \_\_\_\_\_ 48. When the helium bulk tanker is below 3 PSI, close H3244M or H3245M and the vent valve on the bulk helium tanker.
- \_\_\_\_\_ 49. Vent to atmosphere the remaining pressure in the vent line by opening either valve H3243M or H3246M depending on where the vent line is attached.
- \_\_\_\_\_ 50. Disconnect and cap the vent line.
- \_\_\_\_\_ 51. Vent the fill line via valve H9785M.
- \_\_\_\_\_ 52. Disconnect and cap the fill line.
- \_\_\_\_\_ 53. Before the driver of the bulk helium tanker leaves the site, obtain the weight ticket.
- \_\_\_\_\_ 54. Offline, condition the flex line used in the transfer to remove the buildup of water in the line and to make it ready for the next fill.

## **6. Documentation**

- 6.1 The check-off lines are for place keeping only. The procedure is not to be initialed or signed, it is not a record.
- 6.2 The Shift Supervisor shall document the completion of the procedure in the Cryogenics Control Room Log.

**7. References**

- 7.1 Drawing 3A995009
- 7.2 Drawing 3A995064
- 7.3 Drawing 3A995066
- 7.4 Drawing 3A995073
- 7.5 Drawing 3A995084
- 7.6 Drawing 3A995086
- 7.7 Drawing 3A995108

**8. Attachments**

None